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Filed : **September 3, 2003**

REMARKS

By way of summary, Claims 1-16 were originally filed in the present application. Previously, Applicants filed a Terminal Disclaimer in response to double patenting rejections based on U.S. Patent No. 6,521,503. Claims 17-20 have been added herein. Claims 1-20 are pending in the present application. In view of the following remarks, Applicants respectfully request reconsideration and allowance of this application.

Background Discussion: Radiant Heating vs. Resistive Heating

Conventional wafer processing systems often utilize radiant heaters for very high temperature processes, such as epitaxy processing. The benefit of radiant heaters is their ability to rapidly change temperature, such that they are used when the reactor temperature must change or cycle with each wafer. Before a susceptor of these systems is loaded with a wafer, it is at a relatively low temperature, much less than a processing temperature. This reduces thermal shock of a relative cool wafer when the wafer is placed on the susceptor. Once the wafer is positioned on the susceptor, the radiant heaters rapidly heat the wafer for processing. After processing, the radiant heaters let the wafer cool for subsequent removal.

Wafer chucks with resistive heaters are also used to hold wafers during processing. In contrast to radiant heaters cycling between high and low temperatures, these chucks are typically maintained at a somewhat constant temperature due to their large thermal mass. Resistive heaters typically keep the chucks at a constant temperature well below 900°C (e.g., 150 – 600°C).

Significantly, radiantly heated systems are generally not considered interchangeable with resistively heated systems. Radiantly heated systems are used for temperature cycling whereas resistively heated systems are used for maintaining constant, steady temperatures.

Applicants did not invent preheating wafers. However, Applicants were the first to recognize that not only could preheating reduce thermal shock, but it can reduce the amount of temperature cycling by allowing the susceptor to remain at a higher temperature than conventionally employed for such radiantly heated systems. The present application discloses that a wafer is moved over a susceptor, which in the preferred embodiment is at the process temperature of about 900°C or greater. Applicants have determined that the susceptor idle

temperature can be increased to about 900°C or greater, which reduces cycle time. Note that these temperatures are much higher than temperatures typically achieved with chucks employing resistive heaters.

Claims 1-16 Are Allowable Over Savage

Claims 1-16 stand rejected as being unpatentable under 35 U.S.C. § 103 over U.S. Patent No. 6,610,150 to Savage et al. ("Savage"). Applicants respectfully submit that the presently pending claims are patentable over the cited reference as discussed in detail below.

Independent Claim 1

Claim 1 recites:

> A method of processing a substrate on a ***radiantly heated*** substrate support in a high temperature process chamber comprising:
> using a substrate handler to move the substrate into the process chamber to a position above the substrate support;
> ***holding the substrate above the substrate support for a substrate preheat period***;
> ***maintaining the substrate support at greater than 900°C during the substrate preheat period***; and
> putting the substrate on the substrate support at the completion of the substrate preheat period.

Savage does not teach or suggest maintaining a substrate support at temperature greater than 900°C during a substrate preheat period. The Examiner states that it would have been obvious through optimization to maintain the support at a temperature greater than 900 degrees Celsius during a preheat period. Office Action mailed August 10, 2005, page 2. However, routine skill and optimization, as asserted by the Examiner, is not "vary[ing] all parameters or try each of numerous possible choices until one possibly arrived at a successful result, where the prior art gave either ***no indication*** of which parameters were critical ***or no direction*** as to which of many possible choices is likely to be successful." *In re* O'Farrell, 853 F.2d 894; 903, 7 U.S.P.Q.2D 1673 (Fed. Cir. 1988) (***emphasis added***). Savage does not disclose maintaining a substrate support at any particular temperature during the wafer preheat period, let alone the specifically claimed temperatures. As such, the cited reference does not provide any indication of which parameters should be optimized.

Optimization can be and is inventive when it is driven by criteria not recognized by the art of record. As held by the Federal Circuit, "[w]hile the measurement of a physical property may not of itself impart patentability to otherwise unpatentable claims, when the measured property serves to point up the ***distinction*** from the prior art, or ***advantages*** over the prior art, that property is relevant to patentability, and its numerical parameters can not only add precision to the claims but also may be considered, along with all of the evidence, in determination of patentability." *In re* Glaug, 283 F.3d 1335, 1341, 62 U.S.P.Q.2d 1151, 1155 (Fed. Cir. 2002) (***emphasis added***); *see In re* O'Farrell, 853 F.2d 894 (Fed. Cir. 1988); *see In re* Peterson, 315 F.3d 1325, 1330 (Fed. Cir. 2003).

Claim 1 recites a "method of processing a substrate on a radiantly heated substrate support." As the skilled artisan will appreciate such "radiantly heated" systems are typically designed for rapidly cycling temperatures and thus heat and cool a wafer holder between wafers. While Applicants did not invent the concept of preheating, Applicants did invent the recited process recognizing that preheating can reduce the amount of temperature cycling by allowing the susceptor to remain at a higher temperature than conventionally employed for such radiantly heated systems.

Applicants' present application teaches the criticality of the recited temperature range and positioning of the substrate above the substrate support during the preheat period. Applicants have taught the importance of maintaining the substrate support at greater than 900°C during the substrate preheat period. As detailed in paragraph [0021] of the present specification, the wafer is moved into a position over the susceptor, which in the preferred embodiment is at the process temperature of about 900°C or greater, and held for a preheat period. By the end of the preheat period, the wafer has reached an elevated temperature of about 700°C to reduce thermal shock, for example. In recognition of this preheat process reducing thermal shock, Applicants have determined that the susceptor idle temperature can be increased to about 900°C or greater, thus reducing cycle time. Mere optimization cannot arrive at this conclusion without the Applicants' recognition.

Savage does not teach or suggest anything with respect to radiantly heating systems, and thus certainly does not teach maintaining a radiantly heated substrate support at temperatures greater than 900°C during a substrate preheat period. Conventional chucks with resistive heaters

are typically kept at temperatures significantly below 900°C, such that mere optimization would not motivate this modification.

Thus, one of ordinary skill would not reach the Applicants' invention through optimization because the cited reference does not provide any direction as to parameters to optimize, and instead teaches preheating wafers with a wafer chuck. The present application teaches the criticality of the recited temperature range and positioning of the substrate, particularly for the recited radiantly heated system. Accordingly, Applicants respectfully submit that Claim 1 is allowable over the cited reference.

Dependant Claims 2-9

Claims 2-9 depend from Claim 1 and are allowable as depending from an allowable base claim, as well as for novel and non-obvious combination of elements recited therein. For example, Claim 9 recites that during the preheat period, the substrate support and the substrate are heated by means of radiant heating lamps. The Examiner states that it would be obvious to use radiant heat lamps to heat the substrate. However, as noted above, radiant heating is typically employed for rapid heat cycles and used for high temperature processing. During these rapid heat cycles, wafer holders experience significant temperature changes, i.e., the wafer holders are cooled to accept new wafers without causing thermal shock. Chucks having resistive heating elements are typically not thermally cycled at all, and are not employed at such high temperatures.

Even if one of skill in the art modified the Savage system with radiant heat lamps, which Applicants assert they would not, there is no motivation for maintaining a substrate support at an elevated temperature greater than 900°C. Given that radiant heaters are employed for rapid heat cycles, a skilled artisan would be led away from maintaining a substrate support at an elevated temperature greater than 900°C. As such, it is non-obvious to maintain a substrate support at an elevated temperature of 900°C when employing radiant heaters. Thus, Applicants respectfully submit that Claims 2-9 are allowable over the cited reference.

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Independent Claim 10

Claim 10 recites:

> A method of improving the throughput time of a high temperature substrate processing apparatus comprising:
> providing a substrate support within a processing chamber;
> ***providing radiant heating elements spaced above the substrate support;***
> moving a substrate into the chamber;
> ***positioning the substrate at a location spaced between the radiant heating elements and the substrate support;***
> preheating the substrate at the location;
> ***maintaining the substrate support at a process temperature while the substrate is preheating;*** and
> depositing the substrate onto the substrate support after preheating.

Savage does not teach or suggest providing radiant heaters. In contrast to Claim 10, Savage discloses a wafer chuck having an embedded heating element. The Examiner states that it would have been obvious to one of ordinary skill in the art to include radiant heat lamps to heat substrates.

Even if there were a suggestion to modify the Savage teachings with radiant heating elements, which Applicants do not acknowledge, one of ordinary skill in the art would not maintain the substrate support at a process temperature while the substrate is preheating by radiant heating. Radiant lamps are used for their ability to change rapidly the temperature of wafers in a processing chamber. Conventional substrate supports used in processing chambers employing radiant heating elements are not held at the process temperature during a substrate preheat process. As discussed above, substrate supports of processing chambers employing radiant heating elements typically experience significant temperature changes during the production cycle. However, Claim 10 recites maintaining the substrate support at a particular temperature, namely the process temperature, while the substrate is preheated. Given that radiant heaters are employed for rapid and large heat cycles, a skilled artisan would be led away from maintaining a substrate support at the process temperature. As such, it is non-obvious to maintain a substrate support at the process temperature when employing radiant heaters. Therefore, even if Savage were modified with radiant heaters, one of ordinary skill in the art would not maintain the substrate support at a process temperature while the substrate is

preheating. A skilled artisan would have viewed this maintaining of the substrate support at the process temperature as contrary to the whole purpose of utilizing radiant heaters.

Thus, Applicants respectfully submit that Claim 10 is in condition for allowance.

Dependant Claims 11-16

Claims 11-16 depend from independent Claim 10 and are allowable as depending from an allowable base claim, as well as for novel and non-obvious combination of elements recited therein. Applicants respectfully submit that Claims 11-16 are allowable over the cited reference.

New Claims

Claims 17-20 have been added. These claims are fully supported by the application as filed. Accordingly, no new matter has been added by this amendment. Consideration of new Claims 17-20 is respectfully requested.

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Conclusion

For the foregoing reasons, it is respectfully submitted that the rejections set forth in the outstanding Office Action are inapplicable to the present claims. Accordingly, early issuance of a Notice of Allowance is most earnestly solicited.

Any remarks in support of patentability of one claim should not be imputed to any other claim, even if similar terminology is used. Any remarks referring to only a portion of a claim should not be understood to base patentability on solely that portion; rather, patentability must rest on each claim taken as a whole. Applicants respectfully traverse each of the Examiner's rejections and each of the Examiner's assertions regarding what the prior art shows, teaches, or suggests, even if not expressly discussed herein.

Any discussion of embodiments disclosed in the application, and the discussion of the differences between disclosed embodiments and conventional processing systems, does not define the scope or interpretation of any of the claims. Instead, such discussion is to help the Examiner appreciate the important distinctions between disclosed embodiments and conventional systems.

The undersigned has made a good faith effort to respond to all of the rejections in the case and to place the claims in condition for immediate allowance. Nevertheless, if any undeveloped issues remain or if any issues require clarification, the Examiner is respectfully requested to call Applicants' attorney in order to resolve such issue promptly.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

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By: 

Karl L. Klassen
Registration No. 54,224
Attorney of Record
Customer No. 20,995
(949) 760-0404

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